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INVESTIGATION OF VISIBILITY AND  
FORMULATION OF "ASHLESS BLUE FLARE"

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ABSTRACT

The object of this study is to conduct investigations leading to the development of a feasible blue flare formula with the remaining ash residue being as small as possible. After trying numerous formulae a very promising formula was developed containing copper dust, as the molecular emitter, ammonium perchlorate, stearic acid, and paraffin. This report covers all of the physical and chemical tests performed in estimating the feasibility of using the proposed formula in an operational signal.

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INTRODUCTION

The optimum formula, in reference to visual observation, and sensitivity tests contains 74.2% ammonium perchlorate. This amount was necessary to obtain a brilliant blue flame, and any reduction resulted in undesirable flame characteristics. Paraffin was added to desensitize and also serve as a binder. Visual observation of the flame purity was very good when observed in darkness and semi-darkness. However, daylight tests have not been conducted.

FORMULA

Ammonium Perchlorate (oxidizer) . . . . .	74.2%
Stearic Acid (Reducing Agent) . . . . .	11.1%
Paraffin (desensitizer & binder) . . . . .	3.7%
Copper Dust (molecular emitter) . . . . .	11.1%

TEST RESULTS

- (a) Test bodies of 3/4" diameter & length 1 1/8" were used, and a pressure of 8,000 psi was used to press bodies.
- (b) Test bodies burned at a rate of 20 seconds/inch.
- (c) Fuel-oxidizer investigation indicated 74.2% oxidizer and 11.1% reducer to be the optimum ratio.
- (d) Increasing particle size of oxidizer, to increase burning time, reduced the intensity greatly.
- (e) Electrostatic Sensitivity (0.2 mfd Capacitance)

Voltage Volts	4250 Volts - No fire
	2000 Volts - No fire
	1000 Volts - No fire
	500 Volts - No fire
	250 Volts - No fire
	220 Volts - No fire
	200 Volts - No fire

- (f) Impact Sensitivity (ran on impact sensitivity machine)
- |                 |                 |
|-----------------|-----------------|
| 16 cm - No fire | 40 cm - No fire |
| 20 cm - No fire | 50 cm - No fire |
| 25 cm - No fire | 70 cm - No fire |
| 30 cm - No fire |                 |

By dropping block directly on sample the following results were obtained:

30 cm - No fire

40 cm - No fire

41 cm - Fire

42.5 cm - Fire

51 cm - Fire

(g) DTA Analysis:

A severe exotherm occurred at 250°C which was apparently ignition of the sample.

(h) TGA Analysis:

No weight loss was obtained until the temperature of 250°C was reached. Ignition then occurred.

(i) Chromaticity Test:

Flare body 1 5/8" diameter and length 5" composition weight 250 gm, using TNC first fire. Distance 5.75 ft. Burn time 64.6 seconds.

	<u>Test 1</u>		<u>Test 2</u>
Candlepower	-	671	784
DWL	-	567 mu	567 mu
Purity	-	76%	76%

CONCLUSIONS

It appears this formula is very good, in reference to color and residue left after ignition. However, tests should be made in daylight to determine visibility and color. Sensitivity tests indicate that the material should be safe to handle and press.

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